formed, will be equal to the given trapezium or quadrilateral figure ABCD.

Through B, the vertex of the triangle KBC, draw the straight line BI parallel to the base KC, and produce it towards I to any required extent. Bisect the base CK in L, and at the points C and L in the base line CK, erect the perpendiculars CN and LM, meeting the straight line BI in N and M, and making the rectangular parallelogram CLMN equal to the triangle KBC. Upon N as a centre, with NC as a radius, describe the quadrantal arc CmI, meeting BI in I and making NI equal to NC, so that MI is equal to the sum of the sides of the rectangle MN and NC carried out in the same straight line. Bisect MI in H, and on H as a centre, with HI or HM as a radius, describe the semi-circle MGI meeting CN produced in G; then is NG the side of the square that contains the same area as the given trapezium ABCD. Upon the side NG, as thus determined, construct the square NGEF, and that which is required by the problem is done; for the trapezium ABCD, the triangle KBC, the rectangle CNML, and the square NGEF are all equal to one another, so that the figure proposed has been converted into a square of equal area.

Demonstration.—Since, by construction, the triangles ABK and ADK stand upon the same base AK, and lie between the same parallels, AK and BD, they are equal between themselves; take away the triangle ArK, which is common to them both, and the remainder ABr is equal to the remainder KDr, so that the part ABr which is cut off the trapezium by the line BK, is equal to the part KDr, which is applied to it by producing the side CD to meet BK in the point K, and, consequently, the triangle KBC and the trapezium ABCD are equal.

But the rectangle CNML is equal to the triangle KBC, because, by construction, it stands on half the base CL and lies between the same parallels BI, KC, which limit the triangle; therefore, the rectangle CNML is also equal to the trapezium ABCD. And moreover, the square GEFN is equal to the same trapezium or four-sided figure ABCD; for since NG, the side of the square, is a mean proportional between NM and NI, the sides of the rectangle CNML, the rectangle and the square are equal; but the rectangle CNML has been shewn to be equal to the trapezium ABCD, consequently, the square GEFN is also equal to it, for things that are equal to the same thing are equal to one another; hence the trapezium has been converted into a square of equal area, according to the conditions of the problem.

Note.—This problem, simple as the preceding construction appears to be, and undoubtedly is, may be more readily and elegantly resolved by the following method:—

Note.—Should the trapezium, or quadrilateral figure given, assume a different form from the preceding,—that is, should one of the angles be a re-entrant angle, or turned inwards, then the principles of conversion will still be the same; but in order that nothing may be wanting to render the subject plain and intelligible to the learner, we shall resolve a case involving the specified condition.

PROBLEM.—*To construct a square that shall be equal in area to a given quadrilateral, or four-sided figure, having a re-entrant angle, that is, having one of its angles turned inwards; or, to convert a given quadrilateral, or four-sided figure, having a re-entrant angle, into a square of equal area.*

Example.—Let ABCD (fig. 8) be the given trapezium, or four-sided figure, of which the containing sides are AB, BC, CD, and DA, and the angle, BAD, a re-entrant angle; it is required to convert the four-sided figure ABCD into a square of equal area.

Construction.—Join the opposite angles B and D by the straight line BD, which in this case falls wholly without the figure, and at the re-entrant angle A, draw the straight line AK parallel to BD, and meeting the side CD in K; join the points B, K, by the straight line BK, and the triangle CBK shall be equal in area to the given figure. Through the vertex, B, draw BI parallel to CD, and bisect CK in L. At the points C and L in the base CK, erect the perpendiculars CN and LM meeting BI in N and M; then is the rectangle CNML equal to the triangle CBK. On N, as a centre, with NC as radius, describe the quadrant CmI, meeting BI in I, and making NI equal to NC, so that MI is equal to the two sides of the rectangle CN and MN, extended in one line. Bisect MI in H, and on H as a centre, with HI or HM as a radius, describe the semicircle MGI meeting CN produced in G; then is GN the side of the required square; on GN construct the square NGEF, and the thing required is done.

Demonstration.—Since the triangles, BAD and BKD, are constituted upon the same base, BD, and lie between the same parallels, BD and AK, they are equal to one another; take away the triangle ArK, which is common to them both, and the remainder ABr is equal to DrK, so that the part ABr, which is added to the figure by the straight line BK, is equal to the part DrK, which is cut off by the same line.

Note.—The remaining part of the demonstration being precisely the same as in the foregoing cases, it has been thought unnecessary to repeat it.

RAILWAY JOTTINGS.

VARIOUS plans have been noticed in THE BUILDER, for the very desirable and indeed absolutely essential means of communication between guard and engine-driver. An addition to the number, suggested by a correspondent of the *Mining Journal*, consists in the fixation of two perpendicular guide pieces to the funnel of the engine, in which shall slide, facing the driver, a metal plate painted white, with the word "stop," printed on it in black letters, and with a small chain attached, passing over a pulley near the top of the funnel, and carried within reach of the guards. In case the engine is required to be stopped, the plate should be drawn towards the top of the funnel, and kept there till noticed by the driver, which he could scarcely fail to do. The chief defect of this contrivance is, that it does not force itself so instantaneously or effectually on the notice of the driver as might often be requisite. ——A correspondent of *Jerrold's Newspaper*, speaks of a very good and simple means in use in America, for the protection of passengers' luggage, namely the labelling of each article with a copper ticket attached by a thong, while a duplicate copper ticket is handed to the owner which will constitute the only easy means of reclaiming the luggage.——It has been suggested that the sunny sides of railway embankments might be planted with vines instead of lying fallow as they now so universally do. Vineyards, especially in the counties of Kent, Gloucester, and Cambridge, are no novelty in this country, as many of our readers know, extensive vineyards having flourished and prospered here even so early as the 12th century, and without the aid of modern improvements in climate, soil, and management. ——From an account just published by the Greenwich Company, it appears that 108,861 passengers were conveyed by rail during the Sunday and three following days in the fair week, the amount of fare being 2,186*l*.——At a late meeting of the Gravesend and Rochester, it was unanimously resolved to present Messrs. Collier, the secretaries for twenty-three years, with 1,800 guineas, and Mr. Moxon, the chairman of the company for twenty years, with 1,000 guineas.——A locomotive on the South Coast line, thought proper to 'leap' off the rails on Monday week and kill its driver, while the tender fairly severed the stoker's arm from his body. The engine which was one of Stephenson's patent, was one of those curvetting and unsteady ones, which have an incorrigible trick, *as many engines have*, of sliding, or oscillating from side to side, while they also prance and rear, or swing up and down from back to front, so that they are apt and inclined occasionally to 'leap'—literally—off their wheels, or even off the rails, as in the present instance, snapping the connecting irons, which couple it with the tender, by the jerk, and suddenly producing the catastrophe to which such 'high-spirited' practices inevitably lead. Efficient means of training vicious and skittish engines such as these, as the *Times* very naturally calls them, cannot be too soon enforced. ——It appears that not only was the new tunnel at Southampton made to cross and rest upon the old canal tunnel which lately gave way, and that without the knowledge of Captain Coddington, the Government inspector, but it had been also attempted to obtain permission to recross it with sewers, which Mr. Beatty, on the part of the Railway Company, offered to "rebuild if they sank." When the existence of the old tunnel was "thrust upon Captain Coddington's notice," after the occurrence of the catastrophe, he "expressed his surprise at it," and "took a second survey of half-an-hour of the tunnell." The Dorchester company had even been forbidden, through Mr. Beatty, at their own peril, to form those sewers which had been necessarily destroyed, and which it was proposed to reconstruct. It was shewn by Mr. Hill, before the Improvement Board, that there could be no safety for the road above till the old tunnel was filled up; and the only question seems to be, why that was not done before a stone of the new tunnel was laid. "If the engineer who had planned the line of tunnel," said Mr. William Lancaster, at the same board, "could be alone punished, it would not matter how much he suffered; but, unfortunately, contractors, sub-contractors, and other guiltless persons would participate in the loss." Another subsidence has been going on in this ill-conditioned work. —— On Wednesday week before last, the bridge over the Durham and Sunderland Railway, belonging to the Marquis of Londonderry's colliery at Broomside, fell down, and temporarily stopped the traffic upon the railway. Our 'great railway works' appear to be all 'going to sticks,' or stones at least, or bricks.—— The Cheltenham and Oxford bill has passed the ordeal of the Commons' committee, after nearly 170 witnesses, including all the principal engineers in England, had been examined in evidence. Efficient means are provided in the bill for the *well*-being of the water-interest in this celebrated resort of ablutionists and water-drinkers.——The contract for the erection of the railway station at Chester has been let to Mr. Brassey. It is to be finished within nine months after its commencement. The total cost will be about 90,000*l*. —— The bishop of Norwich, at a recent meeting to promote "ragged schools" observed that Mr. Peto, by educating the excavators working on the railways in the county of Norfolk, had beaten the beer-shops out of the field.—— It is still resolved on to open the Newcastle and Berwick line throughout on the 18th inst., although several of the viaducts will not be finished by that time, and are to be substituted by 'sufficient temporary erections.' A 'strong wooden bridge' is also to be thrown across the Tweed at the site of the permanent bridge and partially supported by the piles for it when fixed. The way will thus, in twelve months, be opened up without intermission to railway carriages between Edinburgh, Newcastle, and the south. At the opening, on the 18th inst., however, the time distance between London and Edinburgh will be reduced to thirteen hours!——The travelling carriage of the Russian Prince Gagarin, on its way from St. Petersburgh to Vienna, was destroyed by fire on the 20th ult., on the railway called the Emperor Ferdinand's, some sparks falling upon it from the locomotive. All its contents, which included a part of the wardrobe of the prince and a large quantity of bank-notes, were entirely consumed.

ELECTRO-TELEGRAPHIC PROGRESS.

Messrs. Brett and Little have obtained an injunction against the Electro-Telegraphic Company and others using, without license, their patent percolating hydraulic battery, for the sustainment of the galvanic and electro-magnetic action, by the removal of the sulphate of zinc, as it is generated in the battery, through perforations at the bottom, into cells beneath. —— Improvements (Mapple's) have been effected in the casing and insulating of the wires, by first covering them with cotton and coating with any suitable melted material, then inclosing them in a leaden tube, filled with heated Stockholm tar and pitch, or other non-conducting material, and there kept hot while the leaden tube is reduced by rollers to a smaller or more compact diameter; after which the leaden tube is protected by winding coir-rope round it, and then passing it through a hot pitch bath, and ultimately through a trough of sand, which is well rubbed into the interstices of the rope. For still further protection in underground deposit, the whole apparatus is inclosed in a cast-iron pipe.——It seems to be on this conservative system that the wires are now being laid through the streets of Man-

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